CLAIMS

1. A plasma source apparatus, comprising :
   a. an antenna,
   b. a plasma generation chamber in the proximity of the antenna,
   c. a fluid injector for introducing at least one fluid into the plasma generation chamber,
   d. a radio frequency generator with continuous or pulsed RF power supply

   characterized by the fact that said antenna comprises two conductive loop elements spaced along a common longitudinal axis and at least one axial conductive segment electrically interconnecting said conductive loop elements, each of said conductive loop elements and/or said axial conductive segment including at least one capacitive element.

2. Plasma source apparatus according to claim 1 wherein only said conductive loop elements include at least one capacitive element.

3. Plasma source apparatus according to claim 1 wherein only said axial conductive element includes at least one capacitive element.

4. Plasma source apparatus according to claim 1 wherein said conductive loop elements and said axial conductive segment include at least one capacitive element.

5. Plasma source apparatus according to anyone of the previous claims comprising several axial conductive segments, each axial conductive segment interconnecting said conductive loop elements.

6. Plasma source apparatus according to anyone of the previous claims comprising antenna cooling means such as a chiller , a heat pipe , a Cryo-cooler or a Peltier device.

7. Plasma source apparatus according to anyone of the previous claims comprising thermal control means of the plasma generation chamber in order to avoid thermal shock between the inside and the outside of the plasma generation chamber during especially the plasma ignition.

8. Plasma source apparatus according to anyone of the previous claims comprising a matching network interconnecting the radio frequency generator and the antenna, in such a way as to promote the optimal transfer of radio frequency energy from the radio frequency generator to the antenna.

9. Plasma source apparatus according to anyone of the previous claims comprising a fixed or a moveable shield, enclosing but disconnected from the antenna which is adapted to define or to adjust in real time the optimal electromagnetic coupling between the antenna and the plasma.

10. Plasma source apparatus according to the previous claim wherein the axial conductive element(s) connect(s) directly to the shield through the capacitive element(s).

11. Plasma source apparatus according to anyone of the previous claims comprising a magnetic field generator arranged around the antenna.

12. Plasma source apparatus according to anyone of the previous claims wherein at least one of said capacitive element is tunable.

13. Plasma source apparatus according to anyone of the previous claims wherein said axial conductive element or at least one of said axial conductive segments is twisted.

14. Plasma source apparatus according to anyone of the previous claims wherein at least one of said conductive loop elements is movable.

15. Plasma source apparatus according to anyone of the previous claims coupled with an optical resonator comprising at least two mirrors (one partially reflecting) placed at the limits of the plasma generation chamber. The mirrors are aligned to provide multiple reflections of lightwaves.

16. Plasma source apparatus according to anyone of the previous claims coupled with an apparatus generating cavitation bubbles by ultrasonic waves ; the RF energy is then induces into the interior of the acoustic cavitation bubbles which act as nuclei for the ignition and the maintenance of the plasma. The plasma generation chamber can contain the liquid from where the bubbles are generated.

17. Plasma source apparatus according to anyone of the previous claims coupled with a complementary plasma source as Electron cyclotron resonance source or Ion cyclotron resonance source.

18. Plasma source apparatus according to anyone of the previous claims coupled with a complementary antenna inside or outside the plasma generation chamber.

19. Plasma source apparatus according to anyone of the previous claims wherein the antenna is also adapted as a receiving system to perform Nuclear Magnetic Resonance (NMR) Monitoring or analysis of fluid or a workpiece implemented inside the plasma generation chamber.

20. Plasma source apparatus according to anyone of the previous claims wherein each of said axial conductive segment(s) and/or said conductive loop elements are made with volume conductive wire, or braids wire , typically Litz wire, or hollow wire.

21. Plasma source apparatus according to anyone of the previous claims comprising a network of antennas as defined in the previous claims wherein adjacent pairs of conductive loop elements have at least one common axial conductive segment.

22. A plasma source apparatus according to anyone of the previous claims, being connected to one or a plurality of process chamber.

23. A plurality of plasma source apparatuses according to anyone of the previous claims, each plasma sources being cooperatively connected to at least one process chamber.

24. One or a plurality of plasma source apparatuses according to the previous claims comprising a plurality of RF coils , the RF coils being arranged in a circumferential manner proximate to the process chamber(s).

25. One or a plurality of plasma source apparatuses according to the previous claims wherein at least one RF coils comprises a capacitive element.

26. One or a plurality of plasma source apparatuses according to claim 22, 23,24 or 25 comprising a plurality of magnets , the magnets being arranged in a circumferential manner proximate to the process chamber(s), for exemple, to perform NMR inspection the process chamber and/or the workpiece(s) inside.

27. One or a plurality of plasma source apparatuses according to claim 22, 23, 24,25 or 26 comprising a plurality of electrodes defining a Paul trap type or a Penning trap type on which an oscillating voltage is applied.

28. Use of the plasma source apparatus(es) according to anyone of the previous claims for in situ NMR monitoring of moisture, for example, or the in situ NMR inspection of a process chamber or the in situ NMR analysis of workpieces (e.g. wafers) inside a process chamber.

29. Use of the plasma source apparatus(es) according to anyone of the previous claims wherein the RF excitation is simultaneously applied on one or a plurality ports of the antenna , preferentially, on two ports of the antenna , where the difference between the two ports was a 90° degrees phase shift on the input excitation .